

school age, whereas the most unfortunate sequelae of the disease are seen in still younger children and nurslings. For the protection of this younger group, ordinary quarantine precautions are of little significant value. During early years the only effective precaution is the isolation of the child from everyone who coughs. Only great improvement in treatment, or especially of prophylaxis, will materially reduce the dangers in this critical age group.

Our greatest error in the management of pertussis lies in our failure to regard the disease as really severe, and to regard the patient, with respect to quarantine and treatment, as a significantly ill child.

## STRABISMUS—THE PRESENT STATUS OF ITS TREATMENT\*

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THIS paper will deal only with the most frequent or concomitant type of strabismus in which all the extra-ocular muscles are capable of contracting; but due to various factors the visual axes are not in a state of parallelism, nor can they be brought to the normal position by the volition of the patient.

### UNDERLYING PRINCIPLES

The principles underlying the treatment of this condition are by no means new and really date from the publication of Donders' monumental work on "The Accommodation and Refraction of the Eye," in 1864. It was he who recognized one of the principal factors in the etiology, namely, that in hyperopia (farsightedness) an abnormal effort on the part of the ciliary muscles is necessary in order that clear images may be received on the retinae and that, due to the anatomic and physiologic linkage between the functions of accommodation and of convergence (both are actuated by stimulation of branches of the third nerve), an excess of convergence is an inevitable by-product of the abnormal effort required, which results in the crossing of the visual axes.

It is apparent that this excess of convergence, although equally distributed between the two eyes, cannot be manifest in both eyes at the same time. What happens, therefore, is that the dominant eye fixes the object which has attracted the patient's gaze, and the fellow eye deviates toward the nose to a degree which is roughly proportional, at least in its early stages, to the strength of the nerve impulse which actuates the adductor muscles of the eye. This position, which necessarily becomes habitual, soon results in secondary changes in the muscles themselves. The internal recti tend to become hypertrophied and spastic; the external recti to become stretched and attenuated.

Recent anatomical studies on the osteology of the orbits tend to show that the depth and inclination of the orbital walls may be factors in producing the hyperopia. Certain anomalies of length, strength, and attachment of the extra-ocular muscles do exist and account for a small percentage of ocular deviations of all sorts. Yet

in non-paralytic squint, Donders' principle is always a factor which must be taken into account.

Sherrington's law of reciprocal innervation (the relaxation of the extensors when the flexors are stimulated, and vice versa) was a result, at least in part, of his work on the extra-ocular muscles, and modern students of the problems of strabismus utilize this knowledge, as will be shown presently.

### IMPORTANCE OF EARLY CONSIDERATION

Strabismus of the type under consideration naturally manifests itself in childhood, sometimes very early. In the past, all too frequently general practitioners and pediatricians, following the teachings of oculists who were not particularly conversant with, or interested in, the problem, have advised no treatment until about the seventh year of age. This is obviously wrong. There is a rapidly growing recognition of the untoward psychological effects of strabismus, and a greater utilization of the principles of treatment which naturally follow from a study of the etiology is becoming more widely disseminated. It was obvious to Donders and his contemporaries that convex glasses, to minimize the accommodative effort, would have a favorable effect upon the excess convergence, and where strabismus does not develop too early, and too many secondary changes have not occurred before treatment is instituted, excellent results may be secured by the use of glasses. With the development of more accurate methods of refraction which are applicable to young patients, the percentage that can be cured or helped by means of glasses naturally increases. The fact that small uncorrected astigmatic components of the total refractive error exercise a relatively large stimulus to convergence is not sufficiently appreciated by most oculists at the present time. One-half a diopter of uncorrected astigmatism calls for a constant focusing and refocusing of the eyes, and here is one place where Sherrington's law becomes important. This small but constant accommodative effort is necessary even though all the spherical error has been corrected by glasses, and successful relaxation of the internal recti may hardly be expected unless this excessive stimulation is also removed.

### SUBNORMAL VISUAL ACUITY OF SQUINTING EYES

It is well known that the visual acuity of squinting eyes is subnormal in about 90 per cent of cases. This is traditionally explained by the fact that when the visual axes are not both directed toward the object viewed, diplopia inevitably results. Diplopia, or double vision, is a very confusing and almost insuperable annoyance, as is clearly shown by the behavior of adults who suddenly acquire diplopia from the paralysis of one or more of the extra-ocular muscles. They instinctively cover one eye to blot out the confusing double images. It has, therefore, been assumed, because no histologic changes in the retina and visual pathways have been discovered to account for the poor vision, that the amblyopia is nature's method of overcoming the confusion which diplopia produces. The physiology and psychology of

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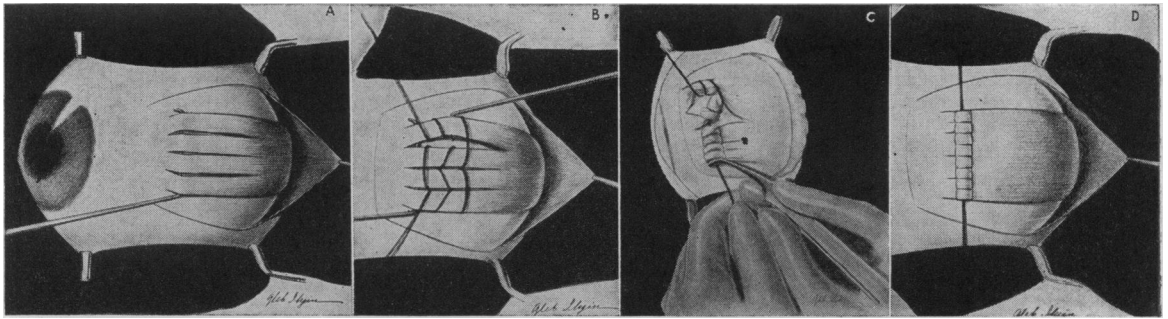


Fig. 1.—Details of the O'Connor cinch shortening operation: (a) tendon of externus exposed and separated into slips; (b) multiple suture in place; (c) transference of loops from suture to tendon slips; (d) transfer completed. The suture is cut off two or three millimeters above the upper border and is allowed to protrude through the conjunctiva at the lower border so that it can be removed when tendon is solidly united in its new position.

the question, however, are far from a final elucidation. Poor vision (amblyopia) in one eye is not a desirable condition, and efforts are now exerted toward its prevention, although the means of preventing it were perfectly well known to Donders and his contemporaries.

#### ATROPINIZATION OF THE NON-DEVIATING EYE

Atropinization of the non-deviating eye is perhaps useful in very young children, where the degree of blurring produced by the atropine is great enough to reduce the visual acuity below that of the fellow eye. A weak atropine solution should be instilled daily or every other day for a period of a month. Six weeks without atropine should then be allowed to elapse. The non-deviating eye should then be atropinized again for a month. In suitable cases this will force the child to use one eye about as much as the other for fixation.

A more effective, but much more troublesome procedure is to bandage the non-deviating eye tightly closed for approximately half of the child's waking hours, while in extreme cases a permanent bandage for days at a time is required until the child is old enough to wear glasses, and longer if the vision in the deviating eye is below that in the fixing eye. There is no agreement among oculists as to when the time to wear glasses has arrived. My own experience indicates that glasses are well tolerated even in very young children (fifteen to eighteen months old) if they are accurately fitted and well designed. The same measures should be taken to insure the use of the deviating eye even after glasses have been prescribed, although under their influence the eyes may be apparently straight to casual observation. With this treatment a substantial number of deviations are cured and binocular vision secured.

#### WHEN LENSES DO NOT BENEFIT

A certain number of cases remain in which secondary changes have occurred or in which the deviation is too great to be completely relieved by glasses. These should be treated surgically. In the past, surgeons have been reluctant to operate much before the seventh year. The multiplicity of operations advocated for straightening eyes, since the first tenotomy for strabismus was performed in 1839, is eloquent testimony to the dissatisfaction of surgeons and parents with all

operative results. Surgeons have come more and more to recognize that, if binocular vision is to be secured in this class of cases, the eyes must be brought into alignment early; but until the publication of the O'Connor technique in 1912 there was no thoroughly reliable method of accomplishing this.

#### FUNDAMENTAL PRINCIPLES IN OPERATIONS FOR CROSSED EYES

All of the seventy-one methods of straightening cross eyes, which are enumerated in the Graefe-Saemisch "Handbuch," with the exception of the O'Connor technique, depend upon one or more of the following fundamental procedures:

1. Free tenotomy, which is uncertain, and has justly fallen into disrepute.
2. Partial tenotomy, which is ineffectual when used as the sole operative procedure.
3. Resection of a portion of the long muscle and reattachment of the shortened distal end to the original insertion.
4. Advancement of the attachment of the long muscle upon the globe.
5. Recession of the short muscle upon the globe.
6. Some combination of these procedures.

All of the conventional resection, recession and advancement operations are open to grave objections. The fibers of the muscle all run parallel to its long axis, and in suturing the muscle back to the smooth, rounded surface of the sclera, almost insuperable difficulties are presented. Although it may be accomplished, it is obvious that if the sutures are tied too tightly constriction and sloughing will occur, and if they are tied too loosely

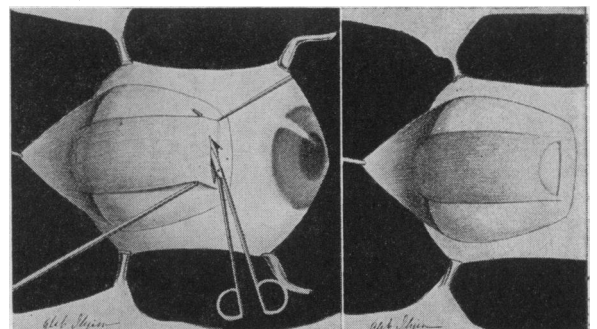


Fig. 2.—Details of central tenotomy of internal rectus: (a) tenotomy in progress; (b) finished tenotomy.

slipping and loss of effect will certainly occur. It is conceivable that there is a middle zone between these two extremes that is effective, but it is unlikely that any surgeon will tie his sutures with just the degree of tension which will always prevent the occurrence of both unfortunate results.

In addition to the difficulty and possible ineffectiveness of scleral suturing, the hazards of perforating the sclera with the needle, particularly in the hands of a beginner, should not be overlooked. The sclera at the site where the long muscle must be reattached in the Worth operation is seven-tenths millimeter thick. Considerable skill is required to lay these sutures accurately and effectively. The hazard of penetration in the recession operation is even greater because the sclera beneath the insertion of the internal rectus near the equator of the eyeball is but 0.5 millimeters thick, and the possible exposure for laying sutures in this region is small.

These measurements are taken from Whitnall's figures, which were compiled from adult sclerae, and they are naturally, of course, somewhat smaller in young patients.

#### TUCKING OPERATIONS

In an attempt to overcome this very obvious difficulty, tucking operations were invented in the interests of safety, so that if the operation were unsuccessful the patient would, at least, be no worse than before operation. Tendon tucking operations are also open to the same objections mentioned above, viz., sloughing and slipping.

#### O'CONNOR OPERATION

The O'Connor procedure which obviates both difficulties is illustrated by Figures 1 and 2.

This technique will permit operation as early as two and a half years, and the prospects of securing binocular vision are thereby very greatly enhanced.

#### DEVELOPMENT OF BINOCULAR VISION

Most oculists agree that only in exceptional cases does binocular vision develop after the age of seven if it has not been present before this age. There is little prospect that binocular vision will develop spontaneously unless the eyes are reasonably close to the normal alignment so that, from every point of view, early operation is advisable.

#### EYE EXERCISES

In the past few years there has been a tremendous growth of interest in so-called eye exercises, or orthoptic training. Doctor Hicks and myself have been able to verify the observations which were made repeatedly by pioneer ophthalmologists that, until the visual acuity of the two eyes is approximately equal, although not necessarily normal (ratio of 20/20 in the better eye to 20/40 or 20/50 in the poorer eye) very little can be accomplished toward the stimulation of binocular vision by orthoptic training. Marlow has shown that the anatomical position of rest of the eyes cannot be permanently altered by exercise. Prolonged orthoptic training in a person with good binocular vision may improve the muscle

balance temporarily. Nevertheless, a prolonged occlusion test will show that the eyes quickly revert to their original position of rest. These principles limit the applicability of this method of treatment to a small percentage of strabismus cases. Many oculists and optometrists who are enthusiastically exercising the eyes of their patients for a few minutes a day, seem to be totally unaware of these principles.

#### SUMMARY

1. The etiology of convergent concomitant strabismus is discussed.
2. The principles of treatment are enumerated.
3. The most important advance in the surgical technique of correcting cases which require operation is described.
4. Binocular vision is briefly discussed.
5. The principles which govern the success or failure of so-called eye exercises are recalled.

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## THE LURE OF MEDICAL HISTORY\*

### MR. JOHN HUNTER ON GENERATION †‡

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#### I

FURTHER words about John Hunter, unless based on new sources, would seem to need justification. For me this lies in the surprising fact that the illustrations accompanying his notes on the development of the "chick of the goose" apparently have never been published, except that Owen included part of the series, in retouched form, in the "Physiological Catalogue," which is difficult of access. Moreover, Hunter's embryological studies still continue to be overlooked or are dismissed with a mere mention. In his new "History of Embryology" as well as in the large work on "Chemical Embryology," Needham gave John Hunter but scant attention and he was given still less in a recent volume on the history of embryology—"Die Embryologie im Zeitalter des Barock und des Rokoko"—by Bilikiewicz (1932). In this work John Hunter was mentioned only in a footnote, while the name of his brother William led the heading of a subdivision. The footnote concerned merely stated that John, the younger brother of William, helped him in the production of the work on the gravid uterus.

#### THE PLACE OF WILLIAM HUNTER IN THE HISTORY OF EMBRYOLOGY

It certainly does not seem just that William should be given a place in the history of embryology, and that John should be denied it. What-

\*A Twenty-Five Years Ago column, made up of excerpts from the official journal of the California Medical Association of twenty-five years ago, is printed in each issue of CALIFORNIA AND WESTERN MEDICINE. The column is one of the regular features of the Miscellany Department, and its page number will be found on the front cover.

† Because John Hunter occupies so large a place in the development of surgery, it is commonly but erroneously assumed that he had the title of Doctor of Medicine.

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